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Designing a Three-Track Internal Carbon Pricing Governance Mechanism in the Real Estate Service Industry

Wan-Yu Weng[1], Yun-Sheng Hsu[2*]

[1] Graduate Institute of Technology, Innovation and Intellectual Property Management, National Chengchi University, Taipei City, Taiwan

[2] Business Ethics and Sustainability Office, Sinyi Group, Taipei City, Taiwan

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ABSTRACT

This study examines how internal carbon pricing (ICP) can be designed as an organisational governance mechanism in the real estate service industry, where carbon emissions are dispersed across daily operations, service processes, and employee behaviours rather than concentrated in production activities. While existing ICP literature has primarily focused on manufacturing and energy-intensive sectors, conventional pricing models are often less effective in real estate service settings, where carbon reduction depends more heavily on organisational coordination, managerial alignment, and behavioural change. To address this gap, this study develops an analytical framework for the real estate service industry, informed by the institutional context of Sinyi Realty and its existing carbon management arrangements. The analysis suggests that ICP in this industry cannot function effectively as a governance tool through price signaling alone; instead, it must be embedded in an integrated institutional design that links short-term motivation, medium-term accountability, and long-term transformation. More specifically, the findings indicate that an effective ICP mechanism in the real estate service industry requires three interconnected governance tracks: short-term carbon reduction incentives to encourage frontline participation and behavioural change; medium-term performance evaluation arrangements that incorporate carbon reduction outcomes into departmental accountability; and long-term reinvestment mechanisms that channel avoided carbon costs into low-carbon technologies and broader organisational transformation. By linking these three dimensions, the proposed framework transforms individual carbon-saving actions into a collective organisational asset and fosters a governance environment in which operational behaviour and corporate development are mutually reinforcing. In this sense, the three-track structure should be understood not merely as a managerial arrangement, but as a set of essential governance conditions through which ICP can become operationally effective in dispersed-emission service contexts. The study further argues that resource allocation across these governance tracks should remain dynamic, enabling organisations to shift gradually from individual mobilization toward more systemic managerial and technological transformation as carbon governance maturity evolves. By reframing ICP as an organisational governance mechanism rather than merely a pricing instrument, this study contributes to the literature on carbon management in the real estate service industry and offers a scalable analytical perspective for firms pursuing net-zero transition.

KEYWORDS Internal carbon pricing (ICP), Service sector, Carbon budget, Carbon governance, Organisational transformation

1. Introduction

Urban decarbonisation has become a central challenge in global climate governance, as cities account for a substantial share of global energy consumption and greenhouse gas emissions (Lo

* Corresponding author. Email address: ys.h@sinyi.com.tw (Yun-Sheng Hsu)

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2014). Within urban systems, the built environment alone accounts for approximately one-third of global CO_2 emissions, highlighting its critical role in achieving net-zero transitions (Magaletti *et al.* 2025). Real estate service companies—including real estate brokerage and property management firms—occupy a particularly important position in this transition. Although they do not directly construct buildings, their extensive branch networks and day-to-day operational activities influence energy consumption patterns and shape the diffusion of low-carbon practices across the built environment, making their carbon governance practices increasingly important for achieving urban decarbonisation.

As governments and corporations increasingly committed to net-zero emissions targets, carbon management became an important component of organisational strategy and risk management. Among various climate policy instruments, carbon pricing emerged as a widely adopted mechanism for incorporating climate-related considerations into economic and managerial decision-making. By assigning an economic value to greenhouse gas emissions, carbon pricing sought to internalize environmental externalities and encourage low-carbon transitions (World Bank 2026, p. 53).

In addition to external carbon pricing mechanisms such as carbon taxes and emissions trading systems, a growing number of organisations began adopting Internal Carbon Pricing (ICP) as part of their climate governance strategies. As the adoption of ICP expanded, organisations increasingly incorporated carbon-related considerations into their management practices and sustainability initiatives.

Despite the growing adoption of ICP, existing research has primarily focused on manufacturing firms, energy companies, and large technology corporations. In these contexts, carbon emissions are often concentrated within production facilities, infrastructure systems, or large-scale investments, allowing carbon management to be directly linked to technological upgrades and capital allocation decisions (Aldy and Gianfrate 2019; Bento and Gianfrate 2020). Comparatively less attention has been given to service-sector organisations, where emissions are frequently dispersed across daily operations and employee behaviour. Consequently, the challenge is often not whether carbon pricing should be adopted, but how carbon-related considerations can be translated into routine organisational practices.

This challenge is particularly relevant in the case of Sinyi Realty, which has already established an internal carbon price of NTD 10,000 per ton of CO_2e but still faces the question of how that price can be translated into practical organisational management (Sinyi Realty Inc. 2024b, p. 52).

Against this background, this study examined how an existing internal carbon price could be transformed into a practical carbon governance mechanism within a chain service organisation. Drawing upon existing ICP literature and corporate practices, this study developed a Three-Track ICP Governance Framework consisting of carbon reduction incentives, performance accountability, and carbon fund reinvestment to facilitate the integration of carbon pricing into routine organisational management.

This study contributed to the literature in three ways: first, it extended ICP research from manufacturing and energy-intensive sectors to the underexplored context of real estate services; second, it proposed a governance-oriented framework that translated an existing carbon price into actionable organisational mechanisms rather than treating ICP as a pricing instrument alone; and third, it introduced a dynamic allocation mechanism that allowed organisations to shift gradually from incentive-driven participation toward systemic carbon governance as organisational maturity evolved.

2. Literature review

2.1. Concept and evolution of internal carbon pricing

Internal Carbon Pricing (ICP) referred to the practice of applying carbon prices within organisations for managerial and decision-making purposes. Unlike government-imposed carbon taxes or

emissions trading systems, ICP functioned as an internally established mechanism through which organisations incorporated climate-related considerations into planning, budgeting, investment evaluation, and operational management (Carbon Disclosure Project (CDP) 2017; World Business Council for Sustainable Development (WBCSD) 2015).

Organisations adopted internal carbon pricing to inform investment decisions, assess climate-related risks and opportunities, and support medium- to long-term strategic planning (Carbon Disclosure Project (CDP) 2017, pp. 19–20). As organisations increasingly integrated climate-related considerations into governance and risk-management processes (Task Force on Climate-related Financial Disclosures (TCFD) 2021, p. 14), more recent literature and practitioner guidance have viewed ICP not only as a financial instrument but also as a governance mechanism that supports organisational planning and decision-making (World Business Council for Sustainable Development (WBCSD) 2025a, pp. 4–5; World Business Council for Sustainable Development (WBCSD) 2025b, pp. 5–6).

2.2. Built environment decarbonisation and urban carbon governance

A separate stream of research examined carbon governance at the urban and built-environment level. Lo (2014, pp. 270–273) reviewed how cities pursued low-carbon transitions through governing techniques such as self-governing, enabling, and governing by authority, arguing that the effectiveness of municipal carbon management depended on the governance mechanisms and institutional capacities through which climate commitments were implemented rather than on emission targets alone. Within the built environment specifically, Magaletti *et al.* (2025, pp. 2–6, 30–31) found that ESG practices reduced building-sector emissions only when supported by consistent, operationally enforceable governance arrangements; certification schemes and disclosure requirements that lacked follow-through at the facility level tended to remain symbolic rather than translating into measurable emission reductions.

Building on Lo's (2014) distinction between self-governing, enabling, and governing-by-authority techniques, governing by authority is broadly comparable to non-pricing, command-based approaches used within organisations—such as mandatory branch-level energy quotas or top-down sustainability mandates—which specify fixed compliance requirements rather than relying on price signals to induce voluntary behavioural adjustment. In service-sector organisations characterised by heterogeneous branch conditions, such uniform mandates may achieve predictable compliance but are less able to accommodate local operating differences than price-based mechanisms such as ICP, which instead rely on voluntary responsiveness to a carbon price.

These findings paralleled the concerns raised in the ICP literature: whether at the scale of a city or an individual organisation, carbon-related instruments appeared to generate sustained outcomes only when embedded within governance structures capable of translating commitments into routine practice. This convergence reinforced the relevance of examining how real estate service firms—positioned at the intersection of urban carbon governance and organisational carbon management—could operationalize an existing internal carbon price.

2.3. Institutionalization of internal carbon pricing

Previous studies suggested that the effectiveness of ICP depended not only on carbon price levels but also on how carbon-related considerations were embedded within organisational governance systems.

Aldy and Gianfrate (2019, p. 90) argued that internal carbon pricing enabled organisations to anticipate future carbon costs and incorporate climate-related risks into strategic decision-making. Similarly, Bento and Gianfrate (2020, pp. 1–2) found that the adoption of internal carbon pricing was influenced by market conditions, political conditions, and technological factors, which shaped how companies responded to climate-related risks and opportunities. Bento, Gianfrate and Aldy (2021, pp.

97–98) further suggested that broader policy environments and institutional conditions played important roles in shaping corporate carbon pricing practices.

More recent discussions have increasingly emphasised the governance dimension of internal carbon pricing. WBCSD (2025a, pp. 4–5) proposed the concept of a climate overlay, suggesting that climate-related considerations should be integrated into existing financial planning and decision-making processes. Similarly, WBCSD (2025b, p. 6) highlighted the role of internal carbon pricing in linking climate objectives with investment, operational, and procurement decisions. Together, these perspectives suggest that the effectiveness of ICP depends not only on the carbon price itself, but also on how carbon-related considerations are embedded within organisational governance and management systems.

2.4. Internal carbon pricing and behavioural change

Although existing ICP research primarily focused on investment decisions, climate risk management, and strategic planning, several studies suggested that organisational behaviour played an important role in achieving long-term decarbonisation outcomes.

This perspective was closely related to Self-Determination Theory (SDT). According to Deci and Ryan (2000, pp. 235–238), individuals were more likely to internalize externally imposed rules and values when organisational environments supported their needs for autonomy, competence, and relatedness. Rather than relying solely on rewards or penalties, organisations therefore required mechanisms that facilitated the transition from externally driven compliance to more autonomous forms of participation.

Related findings were also observed in environmental management research. Li *et al.* (2020) found that pro-environmental behaviour was positively associated with autonomous motivation and organisational support, while Zhu *et al.* (2022) suggested that the effectiveness of carbon management initiatives depended not only on pricing signals, but also on organisational learning, capability development, and environmental strategy transformation.

Together, these studies suggested that carbon pricing alone might be insufficient to generate sustained behavioural change. Effective carbon governance therefore required mechanisms capable of connecting carbon-related incentives with employee participation, organisational learning, and managerial accountability.

2.5. Research gap

Although existing studies have demonstrated the strategic and governance functions of internal carbon pricing, limited attention has been given to how existing carbon prices can be translated into routine management practices within service-sector organisations. This gap is particularly relevant for companies whose emissions are primarily associated with dispersed operational activities and employee behaviour rather than large-scale industrial processes.

Accordingly, this study addressed the following research question:

How could an existing internal carbon price be transformed into a practical carbon governance mechanism in a chain service organisation?

To address this question, this study developed a governance framework based on the case of Sinyi Realty.

3. Research context and case implications

3.1. Methodology

This study adopted a qualitative, single-case research design oriented toward conceptual framework development rather than hypothesis testing. Sinyi Realty was selected as the focal case because it represented a chain service organisation that had already adopted an internal carbon price but had not yet operationalised it through a defined governance mechanism, making it well suited to

addressing the research question (Yin 2018). Primary data sources included Sinyi Realty's sustainability and TCFD disclosures (Sinyi Realty Inc. 2024a; Sinyi Realty Inc. 2024b), supplemented by publicly available ICP practices from seven benchmark organisations spanning manufacturing, technology, and service contexts (Delta Electronics, Chunghwa Telecom, Microsoft, Google, Shell, IKEA, and Starbucks). These organisations were selected to capture a spectrum of ICP governance approaches—ranging from fee-based systems to shadow pricing and disclosure-oriented practices—and to contrast capital-intensive, investment-driven industries with chain-based service organisations more structurally comparable to Sinyi Realty. Data on these organisations were gathered through a systematic content analysis of their publicly available sustainability, TCFD, and climate-related reports, focusing on the type of ICP mechanism adopted, its stated purpose, and the presence of an associated fund structure. These benchmark cases were analysed through cross-case comparison to identify recurring governance patterns, which were then synthesized with institutional ICP literature and behavioural insights from Self-Determination Theory (Deci and Ryan 2000) to inductively develop the proposed Three-Track ICP Governance Framework. As a single-case, document-based design, the approach prioritized analytical depth and contextual richness over statistical generalizability.

3.2. Lessons from existing internal carbon pricing practices

Existing corporate practices demonstrated that internal carbon pricing (ICP) could be implemented through a variety of governance approaches depending on organisational objectives and industrial characteristics. Among Taiwanese corporations, Delta Electronics adopted an internal carbon fee system linked to a dedicated climate fund, while Chunghwa Telecom primarily applied shadow pricing to support investment evaluation and renewable energy planning (Chunghwa Telecom Co. 2024, p. 51; Delta Electronics 2025). Internationally, Microsoft integrated internal carbon fees with a climate fund mechanism, whereas Google emphasised carbon information management and digital carbon governance tools. Shell incorporated internal carbon pricing into carbon budgeting and climate scenario planning processes (Google LLC 2025, pp. 14-16; Microsoft 2025, pp. 5-6; Shell plc 2025, p. 369).

Although these practices differed in their implementation, they shared a common characteristic: internal carbon pricing was embedded within broader organisational management processes rather than functioning solely as a carbon accounting tool. These cases therefore illustrated multiple pathways through which organisations translated carbon pricing into governance mechanisms, providing important insights for the development of an ICP framework suitable for service-sector organisations.

3.3. Service-sector decarbonisation challenges

Compared with manufacturing and technology firms, service-sector organisations often face distinct carbon management challenges. Emissions are typically associated with electricity consumption, building operations, and daily employee activities rather than production equipment or large-scale industrial processes. Consequently, emission reductions frequently depend on behavioural change, organisational participation, and management practices rather than technological upgrades alone.

The experiences of IKEA and Starbucks reflected these characteristics. Rather than relying primarily on investment-oriented approaches, both companies incorporated climate objectives into operational practices and behaviour-oriented initiatives (Inter IKEA Group 2025, pp. 9–10; Starbucks Coffee Company 2025, p. 3, 24). These cases suggested that effective carbon governance in service organisations required mechanisms capable of connecting climate objectives with routine operational behaviour.

The comparison between manufacturing-oriented and service-oriented practices further indicated that a single ICP model was unlikely to be universally applicable. Governance mechanisms

therefore needed to be adapted to organisational characteristics, emission structures, and operational contexts.

3.4. Sinyi Realty as a service-sector ICP case

As a chain service organisation, Sinyi Realty's emissions were primarily associated with electricity consumption across a large network of branch offices rather than production equipment or industrial processes (Sinyi Realty Inc. 2024a, p. 32). Consequently, carbon reduction outcomes depended heavily on operational management and employee participation.

In addition, Sinyi had already established an internal carbon price of NTD 10,000 per ton of CO_2e and incorporated climate-related considerations into its sustainability governance framework (Sinyi Realty Inc. 2024b, p. 52). Therefore, the company was not facing the challenge of whether to adopt internal carbon pricing, but rather how to operationalize an existing carbon price within routine organisational management.

These characteristics made Sinyi an appropriate case for exploring how internal carbon pricing could be translated into a practical carbon governance mechanism. The observations above formed the basis for the development of the proposed Three-Track ICP Governance Framework.

4. Development of the three-track ICP governance framework

4.1. Framework design logic

The literature review and case analysis suggested that existing ICP practices primarily focused on investment decisions, climate risk management, and resource allocation. While these approaches were effective in manufacturing and technology sectors, they were less directly applicable to service-sector organisations characterised by dispersed emissions and branch-based operations.

In the case of Sinyi Realty, emissions were primarily associated with electricity consumption across multiple branch offices. Consequently, carbon management outcomes depended less on technological upgrades and more on employee behaviour and operational management. Under such conditions, the existence of an internal carbon price alone was unlikely to generate sustained carbon reduction outcomes unless carbon-related considerations were incorporated into routine organisational practices.

To address this challenge, this study developed a Three-Track ICP Governance Framework that integrated carbon reduction incentives, performance accountability, and carbon fund reinvestment. Rather than treating internal carbon pricing solely as a financial instrument, the framework sought to transform carbon pricing into a practical governance mechanism capable of influencing organisational behaviour and management processes.

The framework was developed based on two complementary perspectives. First, previous studies suggested that the effectiveness of ICP depended on its integration into broader governance systems (Aldy and Gianfrate 2019; World Business Council for Sustainable Development (WBCSD) 2025a; World Business Council for Sustainable Development (WBCSD) 2025b). Second, Self-Determination Theory suggested that long-term behavioural change was more likely to occur when external incentives gradually became internalized into individual values and organisational norms (Deci and Ryan 2000).

Accordingly, the framework aimed to connect short-term participation incentives with long-term governance mechanisms, thereby supporting the transition from carbon awareness to organisational carbon management.

4.2. Three-track governance mechanism

The proposed framework consisted of three interconnected components: carbon reduction incentives, performance accountability, and carbon fund reinvestment.

The first track focused on carbon reduction incentives. Branches that achieved carbon reduction targets would receive incentive rewards based on avoided carbon costs. The purpose of this mechanism was to strengthen participation and increase awareness of carbon management during the early stages of implementation.

The second track focused on performance accountability. Carbon-related indicators were incorporated into branch management and performance evaluation systems. To ensure comparability among branches of different sizes, electricity consumption per square meter (kWh/m^2) was adopted as the primary management indicator. Through this mechanism, carbon management responsibilities became part of routine operational management rather than remaining voluntary sustainability activities.

The third track focused on carbon fund reinvestment. A dedicated carbon fund was established to support future carbon management initiatives, including energy-efficiency improvements, employee training, and other decarbonisation projects. Rather than functioning as a penalty mechanism, the carbon fund was designed to strengthen organisational capacity for future climate action.

Branches that exceeded their carbon budget were required to submit an improvement plan and could draw on the carbon fund to finance corrective measures, while incentive rewards under the first track were funded solely from a branch's own avoided carbon cost. This kept accountability administrative rather than financially punitive, consistent with the autonomy-supportive rationale of Self-Determination Theory (Deci and Ryan 2000).

Together, these three tracks connected carbon reduction outcomes with incentives, accountability structures, and future investment resources, thereby transforming internal carbon pricing into a practical governance mechanism.

To illustrate, suppose a branch reduced its annual electricity-related emissions by 3 tons of CO_2e relative to its carbon budget. At the internal carbon price of NTD 10,000 per ton, this generated an avoided carbon cost of NTD 30,000. During the early implementation stage, this amount was allocated across the three tracks at an indicative ratio of 80% to incentive rewards (NTD 24,000 returned to the branch as a performance bonus), 10% to performance accountability administration (NTD 3,000 supporting the maintenance of branch-level carbon dashboards and kWh/m^2 benchmarking), and 10% to the carbon fund (NTD 3,000 reinvested in energy-efficiency upgrades and training). As the organisation matured and shifted toward the governance-oriented stage, this ratio was expected to shift toward a smaller incentive share and a larger carbon-fund share, consistent with the dynamic transition mechanism described below.

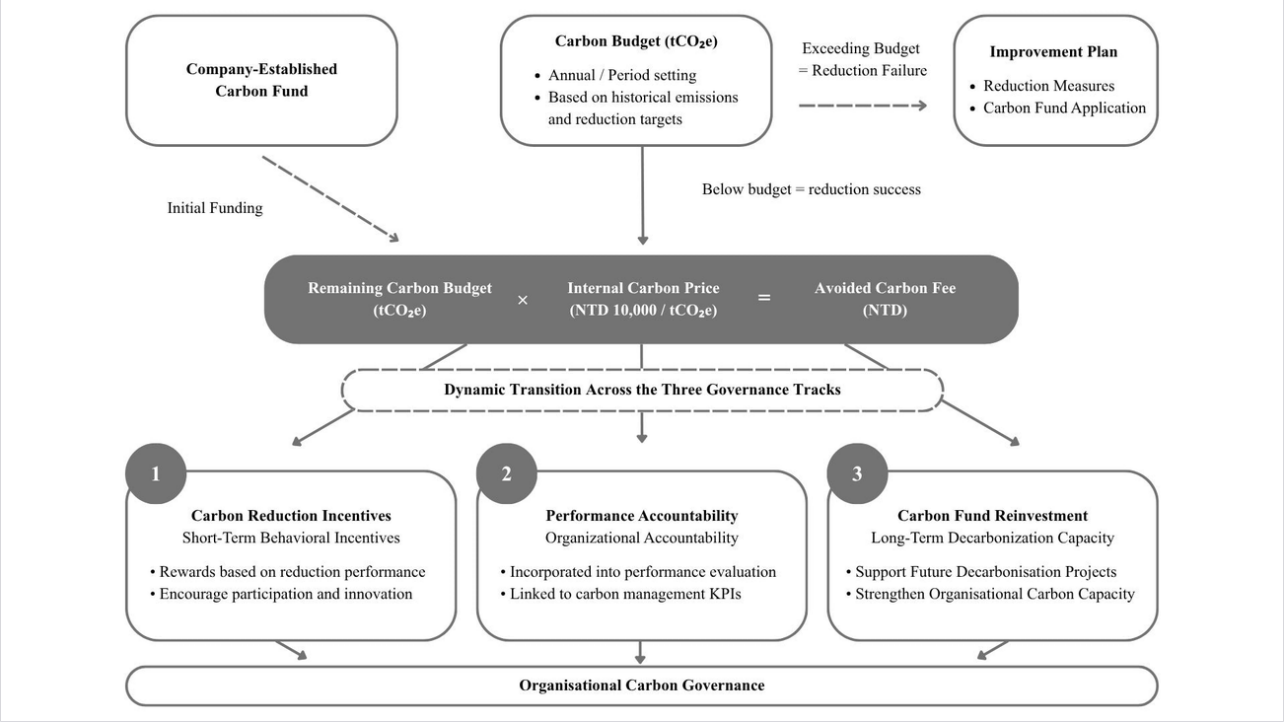

Figure 1. Three-track ICP governance framework.

Note: The carbon fund is established by the company as the financial source of the system. Avoided carbon cost is calculated based on each unit's carbon reduction performance and allocated across the three governance tracks. Allocation ratios may be adjusted according to organisational maturity and carbon management objectives. Units exceeding the carbon budget are not subject to a direct monetary penalty; instead, they are required to submit improvement plans and may apply for carbon fund support to support future reduction projects.

4.3. Dynamic transition mechanism

A distinctive feature of the proposed framework was its dynamic allocation mechanism.

Rather than maintaining fixed allocation ratios, the framework adopted a phased transition approach in which the relative importance of incentives, performance accountability, and carbon fund reinvestment evolved over time. During the initial stage, a larger proportion of resources was allocated to incentive mechanisms in order to encourage participation and increase awareness of carbon management. As organisational acceptance increased, greater emphasis was gradually placed on performance accountability and carbon fund development.

This design was developed based on the assumption that organisational acceptance of carbon management would increase gradually over time. Consistent with Self-Determination Theory, external incentives may support initial participation, while long-term behavioural change is more likely to emerge when carbon management becomes integrated into routine organisational practices (Deci and Ryan 2000). Previous studies similarly suggested that organisational support and management systems play important roles in sustaining pro-environmental behaviour (Li *et al.* 2020; Zhu *et al.* 2022).

Accordingly, the framework proposed a gradual transition from an incentive-oriented model toward a governance-oriented model. Incentive mechanisms served as the initial catalyst for participation, while performance accountability and carbon fund reinvestment provided the institutional foundations for long-term carbon governance.

Table 1. Proposed dynamic allocation ratios of the three governance tracks.

Stage	Carbon Reduction Incentives	Performance Accountability	Carbon Fund Reinvestment
Early Stage	80%	10%	10%
Transition Stage	60%	20%	20%
Governance Stage	40%	30%	30%

Note: The allocation ratios presented above are illustrative parameters rather than fixed requirements. Organisations may adjust the relative allocation across the three tracks according to employee acceptance, carbon reduction performance, and organisational carbon management maturity. The proposed ratios are intended to demonstrate a gradual transition from incentive-oriented participation toward long-term carbon governance.

5. Discussion

5.1. Theoretical implications

This study contributed to the growing discussion on internal carbon pricing by highlighting the importance of governance mechanisms in the implementation of ICP. Existing studies primarily examined ICP as a tool for climate risk management, investment evaluation, and strategic decision-making (Aldy and Gianfrate 2019; Bento and Gianfrate 2020; Bento *et al.* 2021). While these functions remained important, the findings suggested that the existence of an internal carbon price alone did not necessarily lead to meaningful organisational change.

The Sinyi Realty case indicated that a key challenge involved translating an existing carbon price into routine organisational practices. In this regard, the proposed framework extended existing discussions by emphasizing the operationalization of carbon pricing through incentives, accountability structures, and reinvestment mechanisms. The findings therefore supported the view that ICP should be understood not only as a pricing instrument but also as part of a broader carbon governance system.

5.2. Managerial implications

The proposed framework may provide practical implications for service-sector organisations that have already established internal carbon prices but face difficulties in connecting carbon pricing with daily operations.

For organisations with dispersed emission sources and limited opportunities for technology-driven emission reductions, carbon management often depends on the extent to which climate-related considerations can be incorporated into routine management processes. Consequently, governance mechanisms that connect climate objectives with organisational behaviour and operational decision-making may be particularly important.

The proposed framework demonstrated one possible approach for integrating carbon pricing into branch-level management through carbon budgeting, performance accountability, incentive mechanisms, and carbon fund reinvestment. These mechanisms may help organisations strengthen the practical implementation of existing carbon pricing systems while supporting long-term carbon governance objectives.

5.3. Limitations and future research

Several limitations should be acknowledged.

First, the proposed framework was developed based on a single-case analysis of Sinyi Realty. Although the case provided valuable insights into the challenges of implementing internal carbon pricing within service-sector organisations, the findings may not be directly applicable to all organisational contexts.

Second, the framework remained conceptual and had not yet undergone practical implementation. Consequently, its effectiveness could not be empirically evaluated within the scope of this study. Future research may examine implementation outcomes and assess whether the proposed governance mechanisms effectively influence organisational behaviour and carbon reduction performance.

Third, the dynamic allocation mechanism was developed based on the assumption that organisational acceptance of carbon management would gradually increase over time. However, the extent to which this assumption holds may vary across organisational contexts and management environments. Future studies may therefore further investigate the conditions under which dynamic governance mechanisms can be successfully implemented.

Finally, future research may explore the integration of digital carbon management tools and real-time carbon information systems into carbon governance mechanisms. Such developments may provide additional opportunities for strengthening organisational awareness and improving the responsiveness of carbon management practices.

In addition, the proposed framework focused primarily on behavioural and managerial governance and did not directly address the physical and operational dimensions of the built environment in which branch offices were located. Carbon fund reinvestment, for instance, could in principle be extended toward facility-level interventions such as energy-efficient lighting and HVAC retrofits, smart metering, or space-use optimisation across branch networks, thereby linking organisational carbon governance with tangible building performance improvements. Future research may therefore examine how governance-oriented mechanisms such as the one proposed here could be coupled with building-level decarbonisation investments, offering a more complete account of how real estate service firms contribute to the broader decarbonisation of the built environment.

6. Conclusion

This study examined how an existing internal carbon price could be transformed into a practical carbon governance mechanism within a chain service organisation. Using Sinyi Realty as the primary case context, the study reviewed the development of internal carbon pricing, analysed domestic and international corporate practices, and explored the challenges of carbon management in service-sector organisations.

The findings suggested that the effectiveness of internal carbon pricing depended not only on the existence of a carbon price but also on the governance mechanisms through which carbon-related considerations were incorporated into organisational practices. While existing ICP research has primarily focused on climate risk management, investment evaluation, and strategic planning, the Sinyi Realty case indicated that organisations may face difficulties in translating carbon pricing into routine operational behaviour when appropriate governance mechanisms are absent.

To address this challenge, this study developed a Three-Track ICP Governance Framework consisting of carbon reduction incentives, performance accountability, and carbon fund reinvestment. Through a dynamic transition mechanism, the framework sought to support the gradual transformation of carbon management from incentive-driven participation to long-term organisational governance.

The study contributed to existing ICP discussions by extending the focus from carbon pricing adoption to carbon governance implementation. In particular, it highlighted the importance of connecting carbon pricing with employee participation, managerial accountability, and organisational learning within service-sector organisations characterised by dispersed emissions and branch-based operations.

Although the proposed framework remains conceptual and requires future empirical validation, the findings suggested that the future development of internal carbon pricing may depend less on the

carbon price itself and more on the governance systems that enable carbon-related considerations to influence everyday organisational decision-making.

By strengthening how real estate service firms such as Sinyi Realty governed carbon-related behaviour within their own operations, the proposed framework offered a pathway through which organisational-level carbon governance could extend outward, through dense branch networks, into the daily energy practices of the built environment. In this sense, the Three-Track ICP Governance Framework spoke not only to organisational carbon management but also to the broader project of urban decarbonisation, echoing Lo's (2014) view that low-carbon transitions depended as much on governing mechanisms as on emission targets themselves. As real estate service firms occupied an increasingly consequential position at the interface between organisational practice and urban carbon governance, embedding carbon pricing within actionable governance structures may prove essential to translating city-level decarbonisation ambitions into everyday organisational reality.

Declarations

Author contributions. Wan-Yu Weng: Conceptualization, Methodology, Investigation, Formal analysis, Data curation, Writing (original draft), Writing (review and editing), Visualization, Project administration, Resources. Yun-Sheng Hsu: Conceptualization, Methodology, Supervision, Project administration, Resources, Writing (review and editing).

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Conflicts of interest. Yun-Sheng Hsu is employed by Sinyi Group, the organisation examined in this study's case analysis. Wan-Yu Weng participated in a project competition organised by Sinyi Group and received the competition prize and conference-related support disclosed in the Funding statement. Yun-Sheng Hsu's scholarly contributions are described in the Author Contributions statement. The authors retained responsibility for the research design, analysis, interpretation, and decision to submit the manuscript. The views expressed in this article are those of the authors and do not necessarily represent the official position of Sinyi Group. The authors declare no other competing interests.

Data availability. All materials used as evidence in this study are publicly available and are cited in the reference list. Meetings held with Sinyi Group during the project competition provided contextual clarification and supported the development of the proposed framework but were not conducted or analysed as formal research interviews. No recordings, transcripts, or participant-level dataset were created from these meetings. No confidential or non-public company information is reported in this article.

Generative AI. During the preparation of this manuscript, the authors used ChatGPT (OpenAI) and Claude (Anthropic) to assist with Chinese–English translation, text organisation, and language editing, and to support the preliminary identification of potentially relevant publicly available sources. All cited materials were subsequently accessed in their original form and independently evaluated and verified by the authors. The AI tools were not used to generate research data, perform the analysis, formulate the findings, or make scholarly interpretations. The authors reviewed and revised all AI-assisted content and take full responsibility for the accuracy and integrity of the final manuscript.

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